MANCHESTER STREET BRIDGE
(NH DOT Bridge No. 186/103)
Merrimack Street (US Route 3) spanning
the Merrimack River
Concord
Merrimack County
New Hampshire

HAER No. NH-28

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, P.A. 19106

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HISTORIC AMERICAN ENGINEERING RECORD

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HAER NO. NH-28

Location:	Manchester Street (US Route 3) spanning the Merrimack River Concord Merrimack County, New Hampshire USGS Concord Quadrangle UTM Coordinates: 19.294800.4785200
Date of Construction:	1933
Engineer:	New Hampshire Highway Department
Contractor:	C.D. Marsh Construction Company (location unknown)
Fabricator:	Lackawanna Steel Construction Corporation, Buffalo, New York
Present Owner:	City of Concord
Present Use:	Vehicular and pedestrian bridge
Significance:	The Manchester Street Bridge (NHDOT Bridge No. 186/103) is significant as the longest through truss bridge in New Hampshire. It is one of only four extant steel combination truss bridges in the state. It embodies the distinctive characteristics of the Pratt and Parker trusses, and is the only combination truss bridge containing a Parker truss, making it significant for its design and engineering (Sverdrup 1982:8). It was fabricated by a prolific bridge builder, Lackawanna Steel Construction Corporation, and is one of many bridges designed by the New Hampshire Highway Department during the early 20th century period. This bridge is significant on a state and local level for its associations with the development of a regional transportation network. This is the fifth bridge at this crossing, which has long been the principal connector route from the city of Concord to points south and east. The present bridge was built as automobile travel increased on US Route 3, which was the central north-south trunk line through the state.
Project Information:	This documentation was undertaken pursuant to a Memorandum of Agreement (MOA) between Federal Highway Administration (FHWA) and the State Historic Preservation Officer (SHPO) in 1995-1996 as a mitigative measure prior to the replacement of the bridge. Prepared by Lynne Emerson Monroe, Kari Ann Federer and Teresa J. Kirker Hill, Preservation Company, 5 Hobbs Road, Kensington, New Hampshire, for the New Hampshire Department of Transportation, Concord, New Hampshire.

1. Geographical Context

The Manchester Street Bridge (also known as the South End or Lower Bridge, NHDOT Bridge No. 186/103) is located on US Route 3, spanning the Merrimack River in the city of Concord in Merrimack County, New Hampshire. The bridge is located at the eastern edge of the urban core of the city, southeast of the downtown area. Concord's central business district is located along North and South Main Streets, which parallel the western bank of the river, just above the flood plain. On the intervale between the downtown and river are the Boston and Maine Railroad tracks and Interstate 93. These four parallel north-south transportation routes of different periods distinctly define the eastern end of the city. The area of Concord on the east side of the Merrimack has always been sparsely settled, but has experienced increased commercial development in the late 20th century.

Together with North and South Main Streets, Water and Manchester Streets form US Route 3, known as the Daniel Webster Highway, which developed in the early 20th century as the central north-south trunk line through the state. The highway follows the west side of the Merrimack River north of Concord, and south of the Manchester Street Bridge follows the eastern side of the river between Concord and Manchester. A parallel north-south road on the west side of the river, now Route 3A, is also a historic route between the two cities.

Immediately northwest of the Manchester Street Bridge is an interchange of Interstate 93, constructed 1963, which replaced Route 3 in importance as the principal north-south highway through the state. On the far (west) side of the interstate, Hall Street with its mix of residential and commercial properties, runs south from Manchester Street Route 3 continues northwest along Water Street, which crosses the railroad tracks at the Water Street Bridge, and enters downtown Concord at the intersection of South Main Street. On the east side of the Manchester Street Bridge, Manchester Street has a mix of modern commercial and industrial properties.

The Manchester Street Bridge is located at a sharp bend in the river. The sloping river banks are wooded, while flat intervale land on either side remains relatively open. Flood waters pass over both approaches. The abutments of the previous bridge are extant several hundred feet downstream, crossing at a different angle. When the existing bridge was built, the approaches to the bridge were realigned and sections bypassed to create a straighter highway.

2. Bridge Description

The Manchester Street Bridge in Concord is a three-span steel combination through truss bridge with riveted connections, consisting of a high Parker truss flanked by two high Pratt trusses. The bridge bears upon reinforced concrete abutments and piers. The two-lane structure is aligned on a northwest-southeast axis with a ninety degree angle of crossing, and a 0.7 percent slope. The end spans are 168′ 9″ long, and the center span 243′ 9″, for an overall length of 590′ 7″ out to out. The roadway is twenty-four feet wide, curb to curb, with an overall width of 27′ 6″ inches between the trusses. Clearance above the roadway is 14′ 3″ at the portals. Cantilevered along the downstream (southwest) side of the bridge is a 5′ 7″ wide sidewalk.

The Pratt trusses, with parallel top and bottom chords and inclined end posts, have a maximum height of 25´. The Parker truss has a polygonal top chord with eleven slopes, 40´ high at the center point. The panels forming the trusses are 18´9″ wide, made up of vertical and diagonal members of different sizes. The Pratt trusses consist of nine panels each, and the Parker truss thirteen. Halved lengthwise, the trusses are symmetrical. The Pratts have four verticals and four diagonals, two crossed at the center panel. The Parker truss has six verticals and seven diagonals. The center six diagonals cross at the center three panels. The two panels to either side of the center panel have an additional horizontal support which intersects with the crossed diagonals. The members consist of a combination of rolled steel I-beams, channels and angles, all connected with 7/8″ or 3/4″ rivets at gusset plates.

The top chords and inclined end posts are riveted H-sections consisting of side channels with flanges turned out, riveted together with cover plates and bottom lattice bars. The bottom chord is a similar combination of two channels, fastened by a series of riveted rectangular tie plates along top and bottom at 3´ intervals. The end posts pass through the deck to intersect the bottom chord.

The vertical posts and diagonal panel braces are I-beams or shapes built up of angles. These web members intersect at the top and bottom chords, to which they are connected with 3/8″ or 1/2″ thick gusset plates. The web members are riveted to the inside of gusset plates, which are in-turn fastened to the inside of the chord members.

A-frame portal bracing, made up of angles riveted to form lacing bars, is located at the ends of each through truss. The top lateral bracing consists of eight steel struts in line with the vertical truss members and seven steel x-members on each of the Pratt spans and twelve steel I-beam struts in line with the vertical truss members and eleven steel x-members on the Parker span. Sway bracing in the plane of each vertical post is formed by the top lateral struts and parallel sway struts with four triangles between. All members are angles, fastened with gusset plates at the points of connection.

The floor system consists of ten principal steel I-beams in each Pratt span and fourteen in the Parker span. The parallel floor beams are riveted to the bottom chords of the trusses. Between each floor beam are eight I-beam stringers laid transversely at 3´ 6″ intervals, carried by connection angles riveted to the webs of the floor beams. Bracing is provided by nine crossing laterals for each of the Pratt truss spans, and thirteen for the Parker truss span. The laterals consist of angles connected with square gusset plates at their intersection and at the intersection of the floor beams and bottom chords.

According to the 1933 specs for the bridge, all exposed steel surfaces were painted with one coat of red oil and lead shop paint, received a coat of aluminum paint in the field, and a second coat the following year.

The bridge deck was replaced in 1960. The reinforced concrete slab floor rests on the stringers and floor beams, with end dams above the end floor beams. The slab is 7″ thick at the curbs, 8″ at the center, for a crown of 1″ in 24´. The wearing course is asphalt, topped with a waterproof bitumen-epoxy mixture. Steel angle curbs replaced the original concrete curbs, which were poured monolithic with the original roadway slab. Drainage is through scuppers along inner edges of curbs at the center of each panel; these were also replaced in 1960. Along the inside of each truss are road rails, consisting of two steel channels bolted to the verticals and to intermediate H-posts.

The 6′ wide original sidewalk is supported by cantilevered sidewalk brackets, consisting of angles in a triangular shaped frame, projecting from the outside of the bottom chord of the trusses opposite the floor beams. The sidewalk floor system consists of three parallel I-beam stringers. The flooring consists of 2″ thick creosoted yellow pine planks laid transversely on nailing strips above each stringer. The existing floor was installed in 1960, replacing the original. The sidewalk railing is 3′ 6″ high, consisting of two steel pipes with 3/4″ rod palings welded to them, supported by rail posts on the outer ends of the sidewalk brackets. Utility pipes are hung on the brackets under the sidewalk. Along the downstream side of the bridge above the sidewalk, creosoted southern pine electrical utility poles, 18-20′ high, are bolted halfway up the outside of the trusses.

The substructure, including abutments and piers, is reinforced concrete. The bridge seat is approximately eighteen feet above the average summer water level of the Merrimack River. The abutments are located on the river bank, back from the average high water line. The semi-stub abutments have flared wing walls. The footings and lower portions of breast walls are below the finished grade of the bank, surrounded by stone back fill. The above grade portion of the breast walls are protected by stone rip-rap on the surface of the embankment. The northwest abutment is supported on forty creosoted timber piles (averaging 27′ long), while the southeastern end of the bridge is on ledge. The rectangular footings measure 12′ X 39′ 6″ and are 4′ high. The breast wall of the northwest abutment is 16′ high and the southeast is 21′. The bridge seat is 3′ deep.

The two solid concrete piers have rectangular footings and stepped elliptical walls, with a batter of 1/2″ in one foot. The northwest pier is supported on fifty-two untreated timber piles (averaging 18′ long), while the southeast pier is on ledge. The footing of the northwest pier is directly below the grade of the river bed, while the footing and lower portion of the southeast pier are below grade. Both are surrounded by stone backfill. The footings measure 12′ X 40′ and are 5′ high. The wall of the northwest pier is 34′ high, and that of the southeast pier is 37′ 10″. The lower portion of the pier wall measures 18′ high on the northwest pier and 21′ on the southeast pier. The average water level is just below this point. The upper portions of both piers are 16′ high. The elliptical pier caps are 2′ high and 6′ wide, with a distance of 27′ 6″ between the pins of the bearings.

The superstructure bears on cast steel bearings, with 5″ pins. The position of fixed and expansion bearings was reversed from that shown on the plans when the bridge was built. The southeast end of the bridge is supported by rockers resting on rocker plates directly on the bridge seat of the abutment. On the southeast pier, the outer Pratt truss is supported by a fixed shoe on a concrete pedestal rising 10″ above the top of the pier. The southeast end of the Parker truss bears on an expansion shoe with roller nest. The northwest end of the Parker truss on the northwest pier is on a fixed shoe, while the Pratt truss is on a rocker, with rocker plate on a concrete pedestal. The northwest end of the Pratt truss rests on a fixed shoe directly on the bridge seat of the northwest abutment. Each bearing is connected to the bridge seat by two anchor bolts under the outer Pratt spans and four anchor bolts under the central Parker span.

3. Historical Background

The Manchester Street Bridge is the fifth structure at this important crossing of the Merrimack River.

Early settlement in Concord was located on the west side of the river, in the vicinity of what became the downtown city center. The South End remained relatively sparsely developed until well into the 19th century. The Merrimack River defined the history of the city and the region through its role as a transportation route and source of water power. The early economy of the region focused on agriculture on the rich alluvial land along the Merrimack, Suncook and Contoocook Rivers, as well as the abundant timber resources. A five mile stretch along the east side of the Merrimack River was known as the "Dark Plains" (later "the Heights"); this area was shunned for settlement because of its thin sandy soil, which was originally covered by a heavy growth of pitch pine, soon cut by the early settlers (Winship 1965; Boutin 1856:543). The Merrimack provided a direct route to transport products from Concord to Boston, and Concord developed as an important regional trading center. The surrounding towns were linked to Concord by an expanding network of roads (Monroe 1990).

Due to its central location and role in the transportation network, Concord was selected as the seat of state government in 1784, and in 1808 it was officially made the state capital (Winship 1965). The road that is now US Route 3, including Manchester Street, was in place by 1784 and a ferry was located near the site of the Manchester Street Bridge (Holland 1784).

The first bridge over the Merrimack in Concord was a toll bridge built at this crossing in 1795, at a cost of $12,000. After the second bridge was completed the following year, there was a bridge at each end of Main Street at the north and south ends of the city center. The original bridge on this site, known as the "Lower Bridge" was a balanced beam bridge, the type used primarily in Concord until about the 1850's (Covered Bridge Society Bulletin 1989; Concord Monitor 8/12/33).

Transportation routes expanded in the early 1800's with the construction of turnpikes. This crossing on the "Road to Pembroke" provided access between Concord and the historic route to Haverhill and Newburyport, Massachusetts, intersecting with the Chester Turnpike farther south. From the east end of the bridge, the "Old Turnpike Road" was a branch that led northeast to the First New Hampshire Turnpike (now US Route 4) (Carrigan 1816). The Merrimack itself continued to provide transportation, particularly after the Middlesex Canal linked the river with Boston Harbor. The Merrimack Boating Company, incorporated in 1812, operated regular cargo boats from a wharf near the bridge for about thirty years (Openo 1979). The railroad arrived in 1842, further enhancing Concord's position as a transportation hub (Monroe 1990). The railroad tracks paralleled the river, and the railroad yards and related industries were located between on the west side of the river and the eastern edge of the city center.

The second bridge at the Manchester Street crossing was built in 1849, and was one of three bridges and a ferry that crossed the Merrimack at that time (Badger 1855). The new bridge was a Town lattice covered bridge of three spans. This structure was lost in a flood on March 27, 1891. A committee on Roads and bridges was immediately appointed by the mayor of Concord to prepare for the building of a new bridge (Covered Bridge Society Bulletin 1989).

Construction began almost immediately, but use of a temporary ferry was required for 241 days. The bridge was built on the same site as the previous one, although another site, about a thousand feet downstream, was considered. The contractors were Hazelton & Abbott of Concord. The structure was a 4-span bridge consisting of two center metal Pratt through trusses, flanked by two Warren pony trusses. It was located downstream of the current bridge. Both abutments and piers were rebuilt. Due to the discovery of quicksand in the vicinity of the west abutment, seventy-six piles were driven, and on these were placed heavy timbers on which the abutment rested. The west pier was supported on heavy headstone, and the east pier and abutments were built on the old foundations which proved to be suitable. The new bridge was 472 feet long, about 15 feet longer than the old structure. It carried a roadway eighteen feet wide and walk five feet wide on the south side. The bridge contained nearly 200,000 feet of lumber and required 124,000 shingles to cover it. The trusses were of spruce and the flooring and the braces were of pine. The figures 1891 were painted on the portals. The entire work with the exception of a portion of the shingling was done by the contractors, who received $19,400. The bridge opened to traffic on November 28, 1891 (Connecticut River Valley Covered Bridge Society 1976). The remains of the old northwest abutment of this bridge are still extant about three hundred feet downstream from the present bridge (Sverdrup 1982:A-2).

Immense changes in transportation took place during the early 1900's, as automobiles and trucks became increasingly common, requiring better road surfaces and roads and bridges able to bear heavier loads and more frequent traffic. The creation of better roads became a prerequisite for bettering the state's economy and encouraging the tourism that was vital to it. In 1903, the New Hampshire legislature passed laws that created the post of state highway engineer, called for a general survey of highways in the entire state, and designated certain roads as state highways. Two years later, the State Aid Law of 1905 was enacted, authorizing the construction and maintenance of highways with state funds and under the supervision of the state highway engineer. In 1909, a system of three trunk line state highways was established, to run from the Massachusetts border, up the valleys of the Piscataqua, Merrimack, and Connecticut Rivers, and converge in the White Mountains (Garvin and Garvin 1988:188-189). The trunk line routes generally followed existing roads, and maintenance remained the responsibility of the cities and towns with assistance from State Aid funds. The Merrimack Valley Road, now US Route 3, was the north south road through the center of the state (Bureau of Public Roads 1927).

A new bridge at the Manchester Street crossing, then known as the South End or Pembroke Bridge, was erected in 1915. It was one of five new steel bridges built by the City of Concord in that year, at a total cost of $80,000. All were designed by Storrs and Storrs. The bridge at this site was built by Berlin Construction Company and erected by Daniel Marr and Son of Boston. Removal of the old structure began on May 12th, and the new bridge opened on August 25th. It was a four span bridge, consisting of two pony Warren trusses flanking two high Pratt through trusses (City of Concord Annual Report 1915; Concord Monitor December 24, 1915). When this bridge was replaced in 1933, the structure was dismantled and reused, two sections in Henniker and one in Tamworth (Concord Monitor 8/11/33; Powelson 1996).

In 1921, 1925 and 1931, sections of the Merrimack Valley Road became a state highway known as the Daniel Webster Highway, running from the Massachusetts line through Nashua, Manchester, Concord, Franklin, Laconia, Plymouth, Woodstock and north to the Canadian border. The Federal Aid Highway Act of 1916, created a system of primary roads, the length of which was not to exceed seven percent of the total highway miles in a given state. In New Hampshire this coincided with the trunk lines, and totalled 989 miles. After 1921, roads encompassed by this system were eligible to receive federal funds (Anonymous n.d.; Federal Highway Administration 1993). In 1925 a federal highway numbering system was created, and the Daniel Webster Highway became US Route 3. In that year, the 16.2 mile stretch of Route 3 between Manchester and Concord saw an average of 3,906 vehicles daily (Bureau of Public Roads 1927).

According to the straight line plans, the highway on the east side of the bridge was paved with asphalt in 1924, topped with a binder in subsequent years. The approaches were graveled in 1933. Originally, sections of the trunk line highways and bridges on them were to be constructed or improved, and subsequently maintained, by the town or city through which they passed, with half of the cost provided by the state through State-Aid (Bureau of Public Roads 1927:15). In 1929 state funds were appropriated for the reconstruction of trunk lines, including bridges and culverts on them by the State Highway Department, over an eight year period. In 1933, the State Highway Department took full control of trunk line reconstruction and maintenance, eliminating the participation of cities and towns (New Hampshire Highway Department 1933). Roads and bridges within compact parts of cities and towns with more than 2,500 inhabitants remained the responsibility of the municipality, but this southeastern edge of Concord was not included within the Urban Compact Zone as it was defined at this time (Perkins 1996).

In 1932, the State spent a total of $10,313.28 on maintenance and construction of the trunk line in Concord, with no expense to the City. In that year, $95,783.19 was appropriated by the New Hampshire Highway Department for the replacement of the Concord bridge on the Daniel Webster Highway, of which $8,520.62 was expended by the end of that year. A sum of $12,500 was appropriated for rebuilding the approaches, of which $10,506.80 was spent (New Hampshire Highway Department 1933). In 1933, $96,352.05 was appropriated for the bridge and $8,997.82 for approaches (New Hampshire Highway Department 1934). Because of its location on a federal highway, federal aid was provided for the construction of the bridge.

The proposed budget for the bridge was as follows:

Substructure	
Excavation below 78.5 (Abuts), 225 c.y. 4.00	900.00
" above 78.5 (Abuts), 580 c.y. 2.00	1160.00
" (Piers), 700 c.y. 6.00	4300.00
Concrete Class "A" (Abuts), 269 c.y. 14.00	3766.00
" " " (Piers), 858 c.y. 12.00	10296.00
Reinforcing Steel, 22900 lbs. $3\frac{1}{2}$	801.50
Untreated timber bearing piles, 1300 LF 50¢	650.00

Creosoted " " ", 1000 LF 75¢	750.00
Rip rap for foundation protection, 1030 c.y. 2.00	2060.00
	24583.50
[error - above should total 34683]	
Superstructure	
Concrete Class "AA," 372 c.y. 14.00	5280.00
[error - above subtotal should read 5208.00]	
Reinforcing Steel, 68504 lbs. $3\frac{1}{2}$	2397.64
Structural Steel, 1089300 lbs. 5¢	54465.00
Asphalt Wearing Surface, 1557 s.y. 1.00	1557.00
Creosoted Y.P. Lumber, 11.5 MftBM 100.00	1150.00
Removal of old bridge	10000.00
	74849.64
	99433.14
[error - above should add up to 99533.14]	
+ 10%	9943.31
	109376.(45)

Plans were drawn by the New Hampshire Highway Department in 1932; the City of Concord is said to have contributed $8,000 for the cost of the plans. The City also provided land valued at $4,200 (Concord Monitor 8/11/33). In January of 1933, shop drawings were prepared by the Lackawanna Steel Construction Corp. Fabrication of the superstructure began on April 15, 1933 and was completed by July 1933 (Concord Monitor 8/11/33).

The new bridge was built about three hundred feet upstream (north) from the old crossing point. New approaches were graded and the old roadway discontinued. The previous bridge remained in use until the new one opened, after which time it was dismantled and removed. The new bridge was formally opened on August 11, 1933, at a dedication ceremony attended by an estimated 5,000-7,000 people. It was reported that: "Last week in the capital city was so quiet that the liveliest event was the opening of the new South End bridge over the Merrimack River on the Daniel Webster Highway, which was closed to travel during the hours of the exercises." The new bridge added "considerably to the safety and convenience of the southern gateway to Concord" (Hanover Gazette 1933).

The State was responsible for subsequent maintenance of the bridge. In 1940 the approaches were paved with bituminous macadam. In 1948-1949 bridge maintenance included cleaning and priming, and two coats of paint, at a cost of $7,102.83. Materials used in the project included 59 gallons of zinc primer, 9 gallons of undercoat gray, and 191 gallons of aluminum paint. Emergency repairs were made to the sidewalk in 1950. In 1954 repairs were made to the false portal.

The bridge was redecked in 1960, with a new reinforced concrete slab, steel curbs, and timber sidewalk. The work was carried out by the State, according to a design by the New

Hampshire Highway Department. Estimate for that work were as follows:

	Quantity	Unit Price	Amount
Type I-1 Hot Asphalt WC (for bridges)	164 ton	20.00	3280.00
Removing Superstructure	1 unit	LS	7000.00
Conc. Class AA	320.8 CY	70.00	22,456.00
Reinf. Steel	65850 lb.	15	9,877.00
Struct. Steel	1 unit	LS	13,300.00
Struct. Timber (Treated)	12.5 MBM	500.00	6,250.00
Uniformed Officer	3000 Hr.	2.50	7500.00
Temp. Guide Rail (Wood)	1 unit	LS	4,500.00
Waterproofing (Bit.-Epoxy Mix)	1 unit	LS	4,700.00
			78,863.50

Following World War II, with the construction of the interstate highway system, Concord was again emphasized as a center of the growing network of highways (Monroe 1990). Interstate 93 replaced US Route 3 as the primary north-south road through the center of the state. An interchange of I-93 is located immediately west of the Manchester Street Bridge, providing access in and out of the southern end of downtown Concord, and bridge carries traffic to the interstate from the east side of the river.

In 1973, the Urban Compact Zone was extended to encompass the Manchester Street Bridge, shifting ownership and responsibility of the bridge entirely to the City of Concord. A small amount of state funding is provided for repairs (Perkins 1996).

The Manchester Street Bridge is presently in poor condition and is slated for replacement. According to a bridge inspection made in October of 1995, the concrete substructure is cracked with heavy spalls, and exposed rebar. The stringers and floor beams are rusted, cracked and holed. The lower chords of trusses are heavily rusted with holed areas. Several diagonals and verticals have experienced minor section loss. The steel angles of the lateral bracing are heavily rusted, holed and damaged. The paint is in poor condition. There are broken welds and sheared bolts. There has been extensive collision damage to the portals and bridge rails. The concrete deck is cracked with heavy spalling and leaking. Rebar is exposed and rusting. The asphalt wearing surface is cracked and settled. The sidewalk timbers are worn, loose, and decayed. The asphalt approach pavement is cracked and settled and has been shimmed at the ends. The granite curbs and paved sidewalks have settled (Concord City Engineer, Bridge Inspection files).

4. Technological Significance

A truss is a framework composed of individual members fastened together so that loads applied at the joints produce only direct tension or compression. In its simplest form every truss is a triangle or combination of triangles (Ketchum 1920:103).

Modern steel truss bridge construction is a descendent of medieval wooden bridge design with king or queen post support systems. In this country, in the early 19th century, bridge builder Theodore Burr of Pennsylvania combined several king post trusses with a wooden arch, creating a new type of stronger bridge (Comp 1977:2). Advances in wood bridge truss design followed, including the Town lattice truss in 1820 and William Howe's use of both wood and wrought iron for additional tension and compression strength in 1840. The metal truss bridge was by far the most common bridge built in this country between 1850 and 1925. Patents for many types of metal and/or wood truss bridges were granted throughout the 19th century. Later improvements included the use of riveted rather than pinned connections and the replacement of wrought iron with steel as a stronger structural material after the introduction of rolled steel for widespread use in 1884 (Comp 1977:2).

Riveted high trusses were used for the longest spans. The Pratt through truss bridge consists of two vertical trusses which carry the floor and load, two horizontal trusses in the planes of the top and bottom chords, which carry the wind load, and crossing bracing at the end posts (portals) and at the intermediate posts (sway bracing) (Ketchum 1920:103).

The Pratt truss was patented by Thomas and Caleb Pratt of Boston in 1844. The Pratt was designed with thin, light vertical members acting in compression and heavier diagonals acting in tension (Comp 1977:3). It differed from the older Howe truss in that the major function of a key member was reversed; by subjecting the diagonals mostly to tension, Pratt reduced the danger of buckling. The reliance on Howe's substantial intermediate verticals was maintained and the greater distinction between the size and function of the diagonals and verticals gave the grid its appearance (Cooper 1987:55). The Pratt truss became one of the most popular metal trusses in the 19th century, because of its strength and straightforward design (Jackson 1988:24). The first Pratt truss bridges in New Hampshire date from the 1890's (Anonymous n.d.). Riveted connections were common on Pratt trusses by the early 20th century, which eased the connection of the floor beams to the verticals above the lower chord, adding to the stability of the truss (Cooper 1987:56).

The Parker truss, and the similar Camelback truss, were variations on the Pratt, with polygonal top chords (Comp 1977:6). The top chords of the Camelback consisted of five slopes, while a Parker truss was a Pratt with polygonal top chords and endposts with more than five slopes. The Parker truss was introduced in the 1870's by C.H. Parker.

> He utilized a quadrilateral truss of the Pratt type with posts in compression and diagonals in tension, but varied the length of the posts based on the strains exerted on them at a given location. The center panels where the strains were greatest, required the tallest panels, with the posts becoming successively shorter toward the ends of the bridge. The primary advantage of the design was a reduction in the weight of the bridge, or dead load, permitting longer spans without increasing the sectional area of the bridge's structural members (Louis Berger and Associates 1994).

The Parker truss was generally economical for spans of over 160 feet, and preference shifted from the Camelback to the Parker in the early 20th century (Cooper 1987:76).

Few metal truss bridges were built in New Hampshire during the same period as the

Manchester Street Bridge; in the 1920's and 1930's, reinforced concrete bridges largely replaced truss designs, due to concrete's reduced maintenance costs, greater availability of materials, and aesthetic appeal (Jackson 1988:38).

Multiple trusses or combinations of trusses were often used to cross long spans The Manchester Street Bridge is is the longest through truss bridge in the state (Sverdrup 1982). It is one of only four combination truss bridges in New Hampshire; the others are in Shelburne (1897), Berlin (1915-16), and Lebanon (1936). The Manchester Street Bridge is the only one containing a Parker truss; the others are various combinations of Pratt and Warren trusses. In 1987, the group of four bridges was reviewed under the NHDOT Bridge Rating System in regard to historicity, technological significance and environmental quality by staff from the State Department of Transportation, Division of Historic Resources and Federal Highway Administration. The Manchester Street Bridge received the second highest number of points, twenty-two out of a possible thirty-eight, behind the Shelburne bridge. The Manchester Street bridge was built during the "mature flourishing phase" of combination truss development in the state and was considered in substantially original condition. It was considered outstanding in its length (590 feet 7 inches) and number of spans (three). It was also deemed noteworthy for its architectural and/or engineering details, including its combination of truss types.

The Manchester Street Bridge was built by a prolific builder of conventional types, the New Hampshire Highway Department under the direction of John W Childs, state bridge engineer. The design was by Sheldon T. Hare, probably under the supervision of Harold E. Langley, assistant bridge engineer. John W. Childs graduated from Dartmouth College in 1909 and began working with the Highway Department in 1916. In 1922 he was appointed division engineer in Littleton and in 1925 state bridge engineer (Concord Monitor September 24, 1942). In that position, he designed and built hundreds of steel, concrete and stone bridges throughout the state and oversaw the construction of all but two New Hampshire bridges between 1925 and 1942 (Concord Monitor September 24, 1942).

The bridge's fabricator was Lackawanna Steel Construction Corporation of Buffalo, New York. Known variously as Lackawanna Bridge Works, Lackawanna Steel Construction, and Lackawanna Steel, this company operated in the early 20th century in the Buffalo area. The firm originated in Scranton, Pennsylvania in the 1840's, as an iron smelter, and in the 1870's it added the Bessemer process to produce steel rails. In 1901 William Scranton, then head of Lackawanna, moved the company to West Seneca, New York, outside of Buffalo, in response to the entreaties of promoters who wanted to establish heavy industry in their region. The influence of the company is reflected in the incorporation of West Seneca in 1911 as the new town of Lackawanna. Lackawanna was purchased in 1922 by the mammoth Bethlehem Steel, which also had major facilities in the Buffalo area, but continued to operate as a subsidy of the larger company (Historic Resources Consultants 1985).

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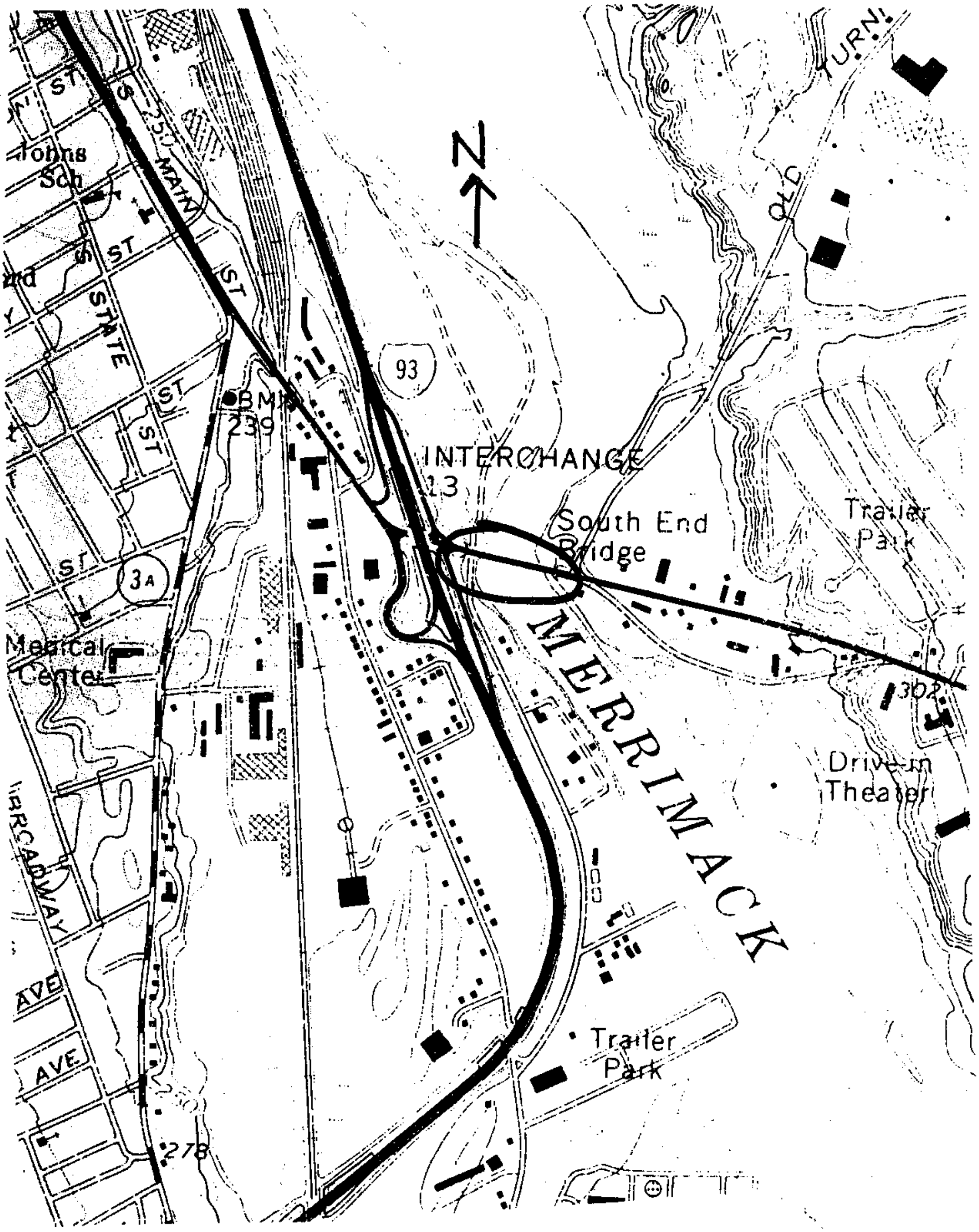
LOCATION PLAN



GRAPHIC DOCUMENTATION

SITE PLAN